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Generalized Geologic Map for Land-Use Planning: Menifee County, Kentucky

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Acknowledgments

Geology adapted from Curl and Petersen (2005), Morris (2005), Murphy and others (2005a, b), Nelson (2005a, b), Nelson and Lambert (2005a, b), Nelson and Petersen (2005), and Palmgreen and Petersen (2005). Mapped sinkhole data from Paylor and others (2004). Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for base-map data.

Menifee County Courthouse at Frenchburg

Menifee County, an area of 204 square miles on the western edge of the Eastern Kentucky Coal Field, was formed in 1869. The northern and western parts of the county are characterized by cliff-lined ridges. The rolling terrain of the south and east has cliffs in the bottoms or midpoints of valley walls. The highest elevation, 1,428 feet, is on a ridge 3/4 mile north-northeast of Fagan. The lowest elevation, 670 feet, is where the Red River leaves the county. The 2005 population of 6,736 was 2.7 percent greater than the 2000 population. There are no traffic lights in the county. Photo by Dan Carey, Kentucky Geological Survey.

Alluvium–Unit 1

Clay, silt, sand, and gravel (unit 1) that form alluvial valleys, providing level land for homes and agriculture, may be subject to poor drainage or flooding. The wide valleys of Beaver Creek (above) and Slate Creek (below) are typical for streams cutting through shales. Siltstone cliffs (unit 5) and sandstone-capped hills (unit 6) bound the valleys. Photos by Dan Carey, Kentucky Geological Survey.

Shale and Siltstone–Unit 3

Three-hundred-fifty-million-year-old shale and siltstone (unit 3—Nancy Member of the Borden Formation) has been cut through by Slate Creek below the Ky. 713 bridge. Photo by Dan Carey, Kentucky Geological Survey.

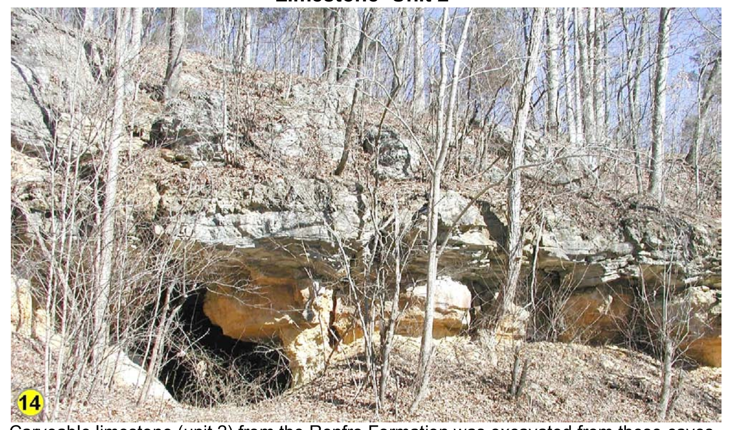
Scenic Beauty

Menifee County is blessed with an abundance of natural beauty. Resistant sandstones of unit 6 created Broke Leg Falls. Photo by Dan Carey, Kentucky Geological Survey.

Sandstone–Unit 6

Sandstone (unit 6) defies wind and rain to preserve the ridgetops. Photo by Dan Carey, Kentucky Geological Survey.

Limestone–Unit 2



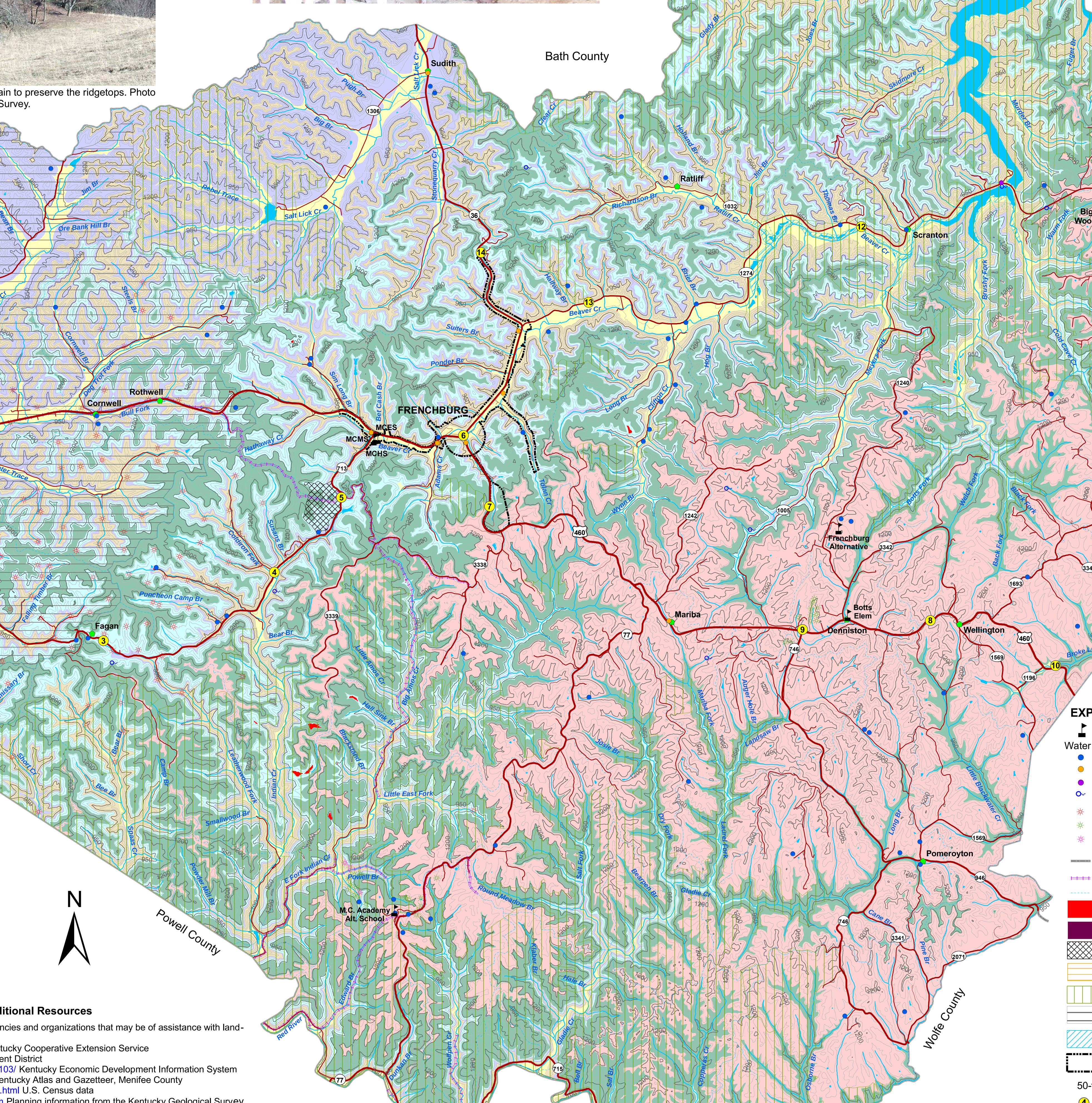
Carveable limestone (unit 2) from the Renfro Formation was excavated from these caves. A rare two weeks of subfreezing weather created the environment for the formation of stalagmite icicles (below). Photos by Dan Carey, Kentucky Geological Survey.

Siltstone, Sandstone, Shale–Unit 5

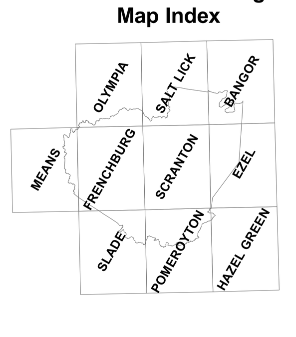
Rockfalls are common in the siltstone and shale of the Cowbell Member of the Mississippian Borden Formation (unit 5) along Ky. 1274. Shale breaks down when wet, destabilizing the siltstone. Photo by Dan Carey, Kentucky Geological Survey.

Sandstone, Siltstone, Shale, Sparse Coal–Unit 6

Sandstone, coal, siltstone, and shale (unit 6) of the Pennsylvanian Lower Breathitt Formation is exposed in this roadcut on U.S. 460 southeast of Frenchburg. Photo by Dan Carey, Kentucky Geological Survey.



7.5-Minute Quadrangle Map Index



Additional Resources

Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Menifee County:
ces.ca.uky.edu/Menifee/ University of Kentucky Cooperative Extension Service
www.gwadd.org/ Gateway Area Development District
www.thinkkentucky.com/edis/cmnty/cw/cw103/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21165.html Kentucky Atlas and Gazetteer, Menifee County
quickfacts.census.gov/qfd/states/21/21165.html U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

EXPLANATION

- School
- Water wells
  - Domestic
  - Monitoring
  - Public
- Spring
- Gas well
- Oil well
- Secondary recovery well
- County line
- Abandoned railroad
- Watershed boundary
- Mapped sinkhole
- Artificial fill
- Quarry
- Pioneer Weapons Wildlife Management Area
- Daniel Boone National Forest
- Source-water protection area, zone 1
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Incorporated city boundaries

50-foot contour interval

Photo location

Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Clay, silt, sand, and gravel (alluvium)	Fair foundation material; easy to excavate. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Slight to severe limitations, depending on type of activity. Subject to flooding. Refer to soil report (Avers and others, 1974).	Slight to severe limitations, depending on type of activity. Subject to flooding. Refer to soil report (Avers and others, 1974).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).	Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Avers and others, 1974).	Seasonal high water table. Subject to flooding. Refer to soil report (Avers and others, 1974).
2. Limestone	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Danger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate to severe limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks possible.	Slight to moderate limitations, depending on topography. Rock excavation likely. Local drainage problems, especially on shale. Sinks possible.	Slight to moderate limitations, depending on topography. Rock excavation. Sinks possible. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations. Rock excavation may be required.	Slight to moderate limitations, depending on activity and topography. Slight limitations for forest or nature preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe limitations. Rock excavation.
3. Shale* and siltstone	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Moderate to severe limitations, depending on activity.	Slight to severe limitations, depending on activity. Slight limitations for forest or nature preserve.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wetness.
4. Shale*, siltstone, sandstone, sparse coal	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, coals, and underclays.	Severe limitations. Thin soils and impermeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes. Drainage problems.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Moderate to severe limitations, depending on topography. Rock excavation. Local drainage problems. Susceptible to landslides.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Slight to moderate limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Rock excavation possible.
5. Siltstone, sandstone, and shale	Good to excellent foundation material; difficult to excavate.	Severe limitations. Thin soils and impermeable rock associated with shales.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Slight to severe limitations, depending on activity. Slight limitations for forest or nature preserve.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation.
6. Sandstone, siltstone, shale*, and sparse coal	Excellent foundation material; difficult to excavate.	Severe limitations. Thin soils and impermeable rock associated with shales.	Severe to moderate limitations. Rock excavation. Steep slopes.	Severe to moderate limitations. Rock excavation. Steep slopes.	Severe to moderate limitations. Rock excavation. Steep slopes.	Severe to moderate limitations. Rock excavation. Steep slopes.	Moderate to severe limitations, depending on activity and slope.	Slight to severe limitations, depending on activity. Slight limitations for forest or nature preserve.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation.

*Shales and clays in these units may shrink during dry periods and swell during wet periods and cause cracking of foundations. On hillsides, especially where seeps and springs are present, they can also be susceptible to landslides.

LAND-USE PLANNING TABLE DEFINITIONS

FOUNDATION AND EXCAVATION

The terms "earth" and "rock" excavation are used in the engineering sense; earth can be excavated by hand tools, whereas rock requires heavy equipment or blasting to remove.

LIMITATIONS

Slight—A slight limitation is one that commonly requires some corrective measure but can be overcome without a great deal of difficulty or expense.

Moderate—A moderate limitation is one that can normally be overcome but the difficulty and expense are great enough that completing the project is commonly a question of feasibility.

Severe—A severe limitation is one that is difficult to overcome and commonly is not feasible because of the expense involved.

LAND USES

Septic tank disposal system—A septic tank disposal system consists of a septic tank and a filter field. The filter field is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the soil.

Residences—Ratings are made for residences with basements because the degree of limitation is dependent upon ease and required depth of excavation. For example, excavation in limestone has greater limitation than excavation in shale for a house with a basement.

Highways and streets—Refers to paved roads in which cuts and fills are made in hilly topography, and considerable work is done preparing subgrades and bases before the surface is applied.

Access roads—These are low-cost roads, driveways, etc., usually surfaced with crushed stone or a thin layer of blacktop. A minimum of cuts and fills are made, little work is done preparing a subgrade, and generally only a thin base is used. The degree of limitation is based on year-around use and would be less severe if not used during the winter and early spring. Some types of recreation areas would not be used during these seasons.

Light industry and malls—Ratings are based on developments having structures or equivalent load limit requirements of three stories or less, and large paved areas for parking lots. Structures with greater load limit requirements would normally need footings in solid rock, and the rock would need to be core drilled to determine the presence of caverns, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

Extensive recreation—Camp sites, picnic areas, parks, etc.

Reservoir areas—The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

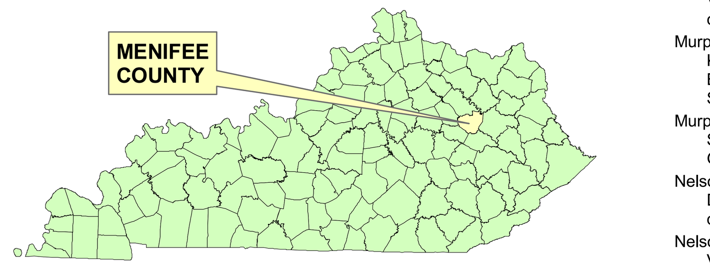
Reservoir embankments—The rocks are rated on limitations for embankment material.

Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

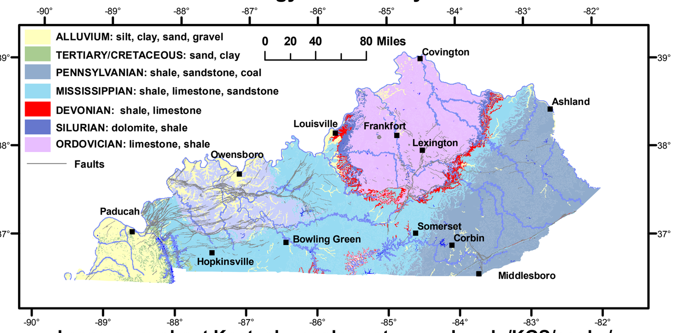
Source-Water Protection Areas

Source-water protection areas are those in which activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

Scale = 1: 48,000
1 inch = 3/4 mile

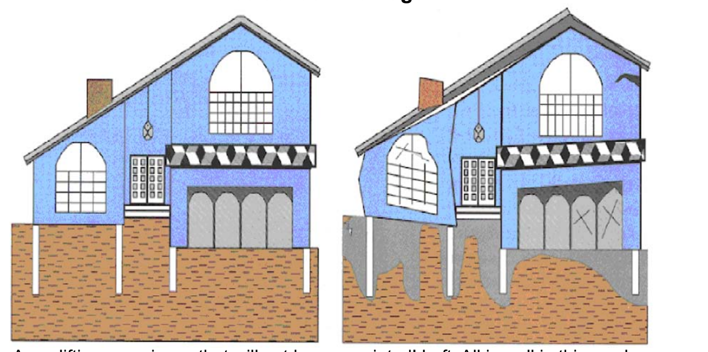


Geology of Kentucky



Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

Residential Drainage



An uplifting experience that will not be appreciated! Left: All is well in this newly built home until water from percolation, drains, lawn sprinklers, leaking sewers, or water mains soaks swelling soil beneath the foundation. Right: With time, expanding soils exert several tons per square foot of pressure on the foundation and shallow pilings. Without remedial measures, the house will actually become deformed, and shatter masonry and windows. Remedies vary from minor maintenance that keeps drainage away from the house to expensive reconstruction of foundations. Prior site planning that takes geology into account is always preferable to dealing with problems after a structure is built. From AIPG (1993).

Sandstone–Unit 6

The Corbin Sandstone Member (unit 6) of the Pennsylvanian Lee Formation is exposed along U.S. 460. Photo by Dan Carey, Kentucky Geological Survey.

Shale and Siltstone–Unit 4

Shale and siltstone (unit 4) in the Pennsylvanian Upper Breathitt Formation is seen in this roadcut at the junction of Ky. 746 with U.S. 460. Photo by Dan Carey, Kentucky Geological Survey.

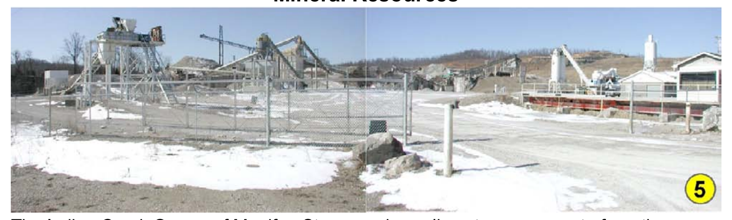
Agriculture

The rolling terrain of unit 4 provides pasture for small beef operations. Photo by Dan Carey, Kentucky Geological Survey.

Logging

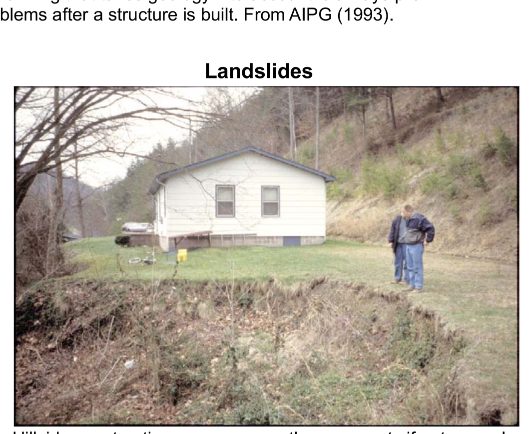
Timber from the hills of unit 6 contributes to the local economy. Photo by Dan Carey, Kentucky Geological Survey.

Mineral Resources



The Indian Creek Quarry of Menifee Stone produces limestone aggregate from the Mississippian Slade Formation (unit 2). Photo by Dan Carey, Kentucky Geological Survey.

Landslides



Hillside construction can cause earth movements if not properly planned. Photos by Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service.

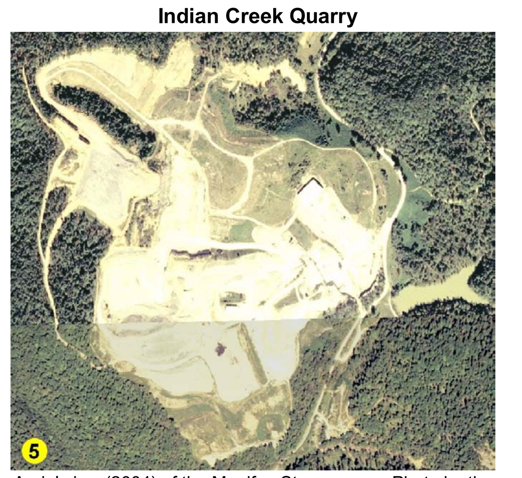
Roadbed Support

Roadways underlain by shale units may require additional support. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater

About 2,000 residents of Menifee County rely on private domestic water supplies: 800 use wells and 1,200 use other sources. Wells in alluvium in the valleys of Slate, Salt Lick, and Beaver Creeks yield only a minimum supply, slightly more than 100 gallons per day. The northwestern half of Menifee County lies in the Knobs physiographic region, in which rocks generally yield only small amounts of water. Wells on hills generally will yield less water than wells in valley bottoms. In the central and southeastern parts of the county, adequate amounts of soft water can usually be found in wells on broad ridges. Wells in the broad valleys supply enough water for domestic use, chiefly through fractures. Salty water may be found in a few wells drilled to depths of 100 feet below the level of the principal valley bottoms. Most groundwater is moderately hard and contains noticeable amounts of iron. Springs are commonly found at the base of sandstone and limestone formations in valley bottoms. Some springs supply enough water for domestic use, but generally have large seasonal variation in flow. For more information on groundwater in the county, see Carey and Stickney (2004).

Indian Creek Quarry



Aerial view (2004) of the Menifee Stone quarry. Photo by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

Slope Failure

Mass movements or landslides of surficial materials are costly geologic hazards in eastern Kentucky. The failure of the slope may be rapid, but more commonly is a slow, almost imperceptible movement, called creep, of a few inches per year. Whether rapid or slow, the end results and damage are similar and costly: broken plumbing, cracked walls and foundations, cracked streets and sidewalks, and commonly total loss of the structures.

Virtually all units containing shale on slopes are subject to landslides.

Shales will break down and weather rapidly when exposed to air and water. Many shaly units tend to swell considerably when exposed to water. For this reason, plumbing trenches under walls and foundations should be prevented from accumulating water.

Gravity is the main driving force, but water nearly always plays a critical role by adding weight and lubricating the slide. Cutting into or overloading a slope with structures and fill can also be major contributing factors.

Precautions include taking care of all surface-water runoff by making certain that all runoff from roofs, gutters, patios, sidewalks, and driveways is carried well away from the house and onto natural slopes; diverting drainage from areas sloping toward the house; cutting into natural slopes as little as possible and avoiding the use of fill; and trying to place the structure on undisturbed bedrock.

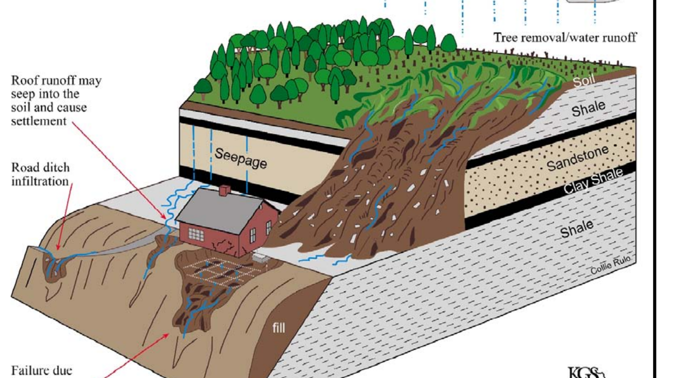
When in doubt, consult an engineering geologist or a geotechnical engineer.

What Are the Factors That Cause Landslides?

Many factors contribute to landslides. The most common in eastern Kentucky are listed below:

1. Steep slopes: Avoid when choosing a building site.
2. Water: Slope stability decreases as water moves into the soil. Springs, seeps, roof runoff, gutter downspouts, septic systems, and site grading that cause ponding or runoff are sources of water that often contribute to landslides.
3. Changing the natural slope by creating a level area where none previously existed.
4. Poor site selection for roads and driveways.
5. Improper placement of fill material.
6. Removal of trees and other vegetation: Site construction often results in the elimination of trees and other vegetation. Plants, especially trees, help remove water and stabilize the soil with their extensive root systems.

Water Can Cause Landslides



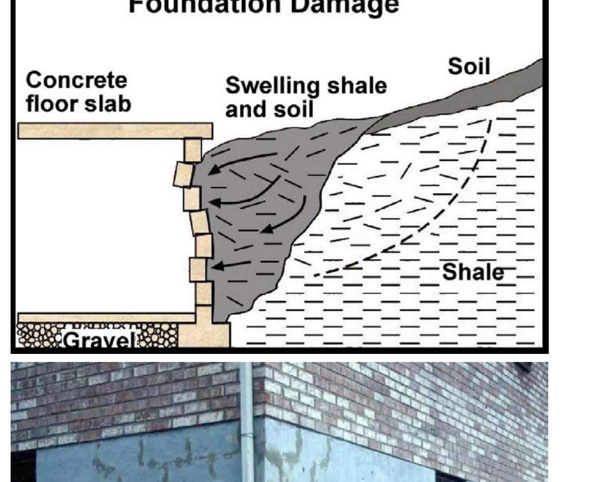
What Are Some Ways to Prevent Landslides?

1. Seek professional assistance prior to construction.
2. Proper site selection: Some sloping areas are naturally prone to landslides. Inspect the site for springs, seeps, and other wet areas that might indicate water problems. Take note of unusual cracks or bulges at the soil surface. These are typical signs of soil movement that may lead to slope failure. Also be aware of geologically sensitive areas where landslides are more likely to occur.
3. Alter the natural slope of the building site as little as possible during construction. Never remove soil from the toe or bottom of the slope or add soil to the top of the slope. Landslides are less likely to occur on sites where disturbance has been minimized. Seek professional assistance before earth moving begins.
4. Remove as few trees and other vegetation as possible. Trees develop extensive root systems that are very useful in slope stabilization. Trees also remove large amounts of groundwater. Trees and other permanent vegetative covers should be established as rapidly as possible and maintained to reduce soil erosion and landslide potential.
5. Household water disposal system: Seek professional assistance in selecting the appropriate type and location of your septic system. Septic systems located in fill material can saturate soil and contribute to landslides.
6. Proper water disposal: Allowing surface waters to saturate the sloping soil is the most common cause of landslides in eastern Kentucky. Properly located diversion channels are helpful in redirecting runoff away from areas disturbed during construction. Runoff should be channeled and water from roofs and downspouts piped to stable areas at the bottom of the slope.

(From U.S. Department of Agriculture, Natural Resources Conservation Service, no date)

Swelling and Shrinking Shales

A problem of some concern in this area is the swelling of some of the clays and shales. Expanding shale can cause backfill to swell and concrete to crack and crumble. It can heave the foundation, the slab and interior partitions resting on it, and damage upper floors and interior partitions. This phenomenon has been responsible for extensive damage to schools, homes, and businesses in Kentucky. During times of drought, these same shales may shrink, causing foundations to drop. Anyone planning construction on these shales should seek professional advice from a geologist or engineer familiar with the problem.



Some shales and the soils derived from them swell when exposed to water or air. These swelling shales and soils can have severe impacts on building foundations and other structures (e.g., bridges, dams, roads). Photo by John Kiefer, Kentucky Geological Survey.

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For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call our Public Information Center at 859.257.3896 or 877.778.7827 (toll free)

View the KGS World Wide Web site at: www.uky.edu/kgs

For Planning Use Only

This map is not intended to be used for selecting individual sites. Its purpose is to inform land-use planners, government officials, and the public in a general way about geologic bedrock conditions that affect the selection of sites for various purposes. The properties of thick soils may supersede those of the underlying bedrock and should be considered on a site-to-site basis. At any site, it is important to understand the characteristics of both the soils and the underlying rock. For further assistance, contact the Kentucky Geological Survey, 859.257.5500. For more information, visit the KGS Community Development Planning Web Site at kgsweb.uky.edu/download/kgsplanning.htm.